US009381021B2

(12) **United States Patent**
**Wagner et al.**

(10) **Patent No.: US 9,381,021 B2**
(45) **Date of Patent: Jul. 5, 2016**

(54) **METHOD AND APPARATUS FOR FORMING A HOLE IN BONE DURING A SURGICAL PROCEDURE**

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( * ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 712 days.

(21) Appl. No.: **13/242,157**

(22) Filed: **Sep. 23, 2011**

(65) **Prior Publication Data**

US 2013/0079780 A1 Mar. 28, 2013

(51) **Int. Cl.**

| | |
|---|---|
| ***A61B 17/00*** | (2006.01) |
| ***A61B 17/16*** | (2006.01) |
| ***A61B 17/17*** | (2006.01) |
| *A61B 17/04* | (2006.01) |
| *A61B 17/88* | (2006.01) |

(52) **U.S. Cl.**

CPC ......... ***A61B 17/1615*** (2013.01); ***A61B 17/1675*** (2013.01); ***A61B 17/1714*** (2013.01); *A61B 17/0401* (2013.01); *A61B 17/162* (2013.01); *A61B 17/1697* (2013.01); *A61B 17/8897* (2013.01); *A61B 2017/0404* (2013.01); *A61B 2017/0414* (2013.01)

(58) **Field of Classification Search**

CPC ........... A61B 17/1615; A61B 17/1714; A61B 17/1675; A61B 17/1635

USPC ....... 606/79, 80, 86 R, 87–89, 96; 623/13.12, 623/13.14

See application file for complete search history.

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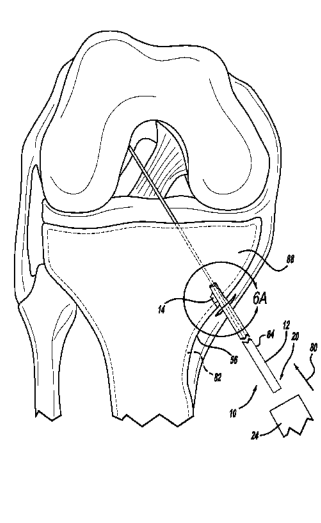
(57) **ABSTRACT**

A method and tool for forming a hole in a bone. The method includes bringing a bone cutting tool extending along a longitudinal axis into engagement with a cortical portion of the bone. A distal portion of the bone cutting tool is passed into the cortical portion of the bone up to a first predetermined depth to form a first bore. The bone cutting tool is then driven in the axial direction to a second predetermined depth to form a keyway portion in the first bore with a cutting tooth of the bone cutting tool. The bone cutting tool is then rotated about the longitudinal axis to form a second bore in a cancellous portion of the bone. The first bore and the second bore have a shoulder extending therebetween. The bone cutting tool is removed from the hole formed by the first and second bores in the bone.

**26 Claims, 14 Drawing Sheets**



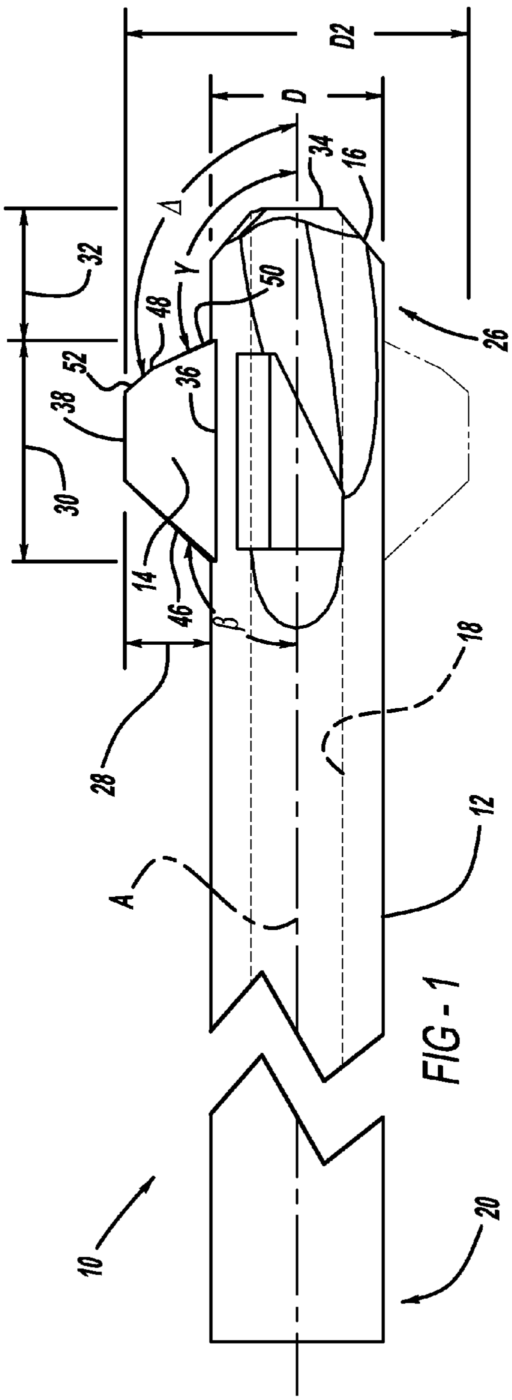

D2
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FIG - 1

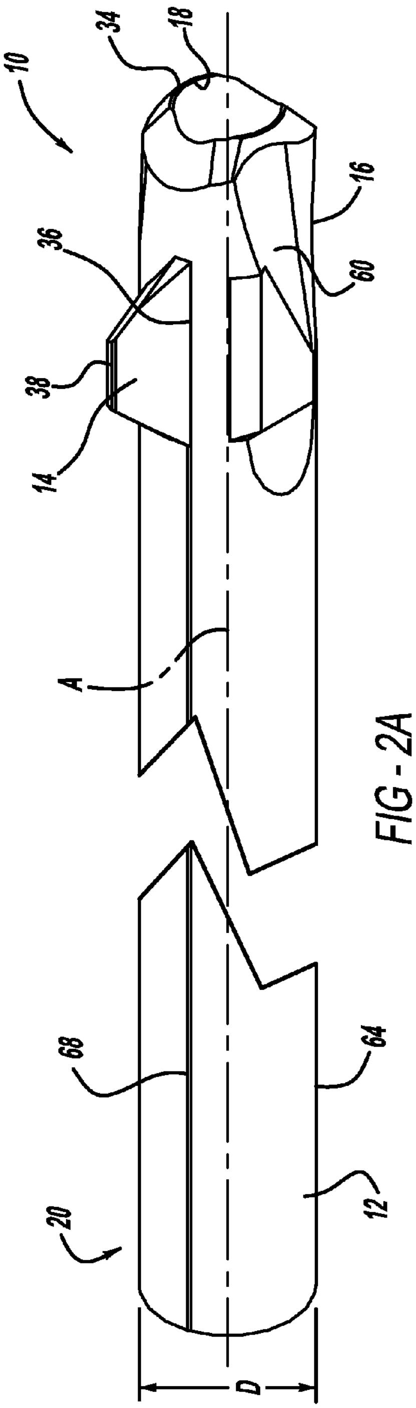
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FIG - 2A

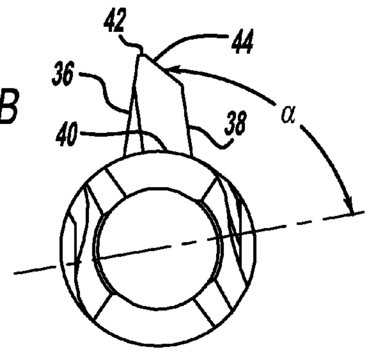


FIG - 2B

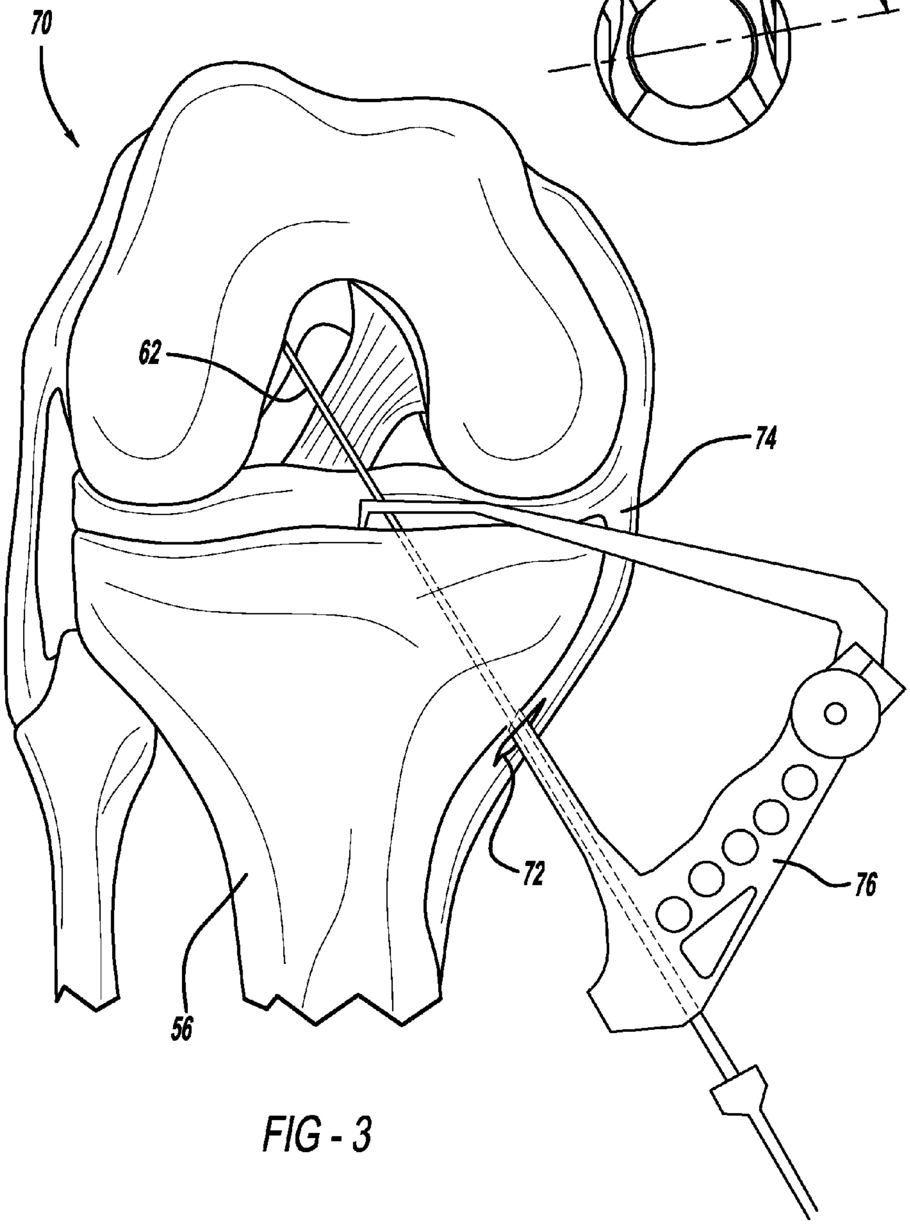


FIG - 3

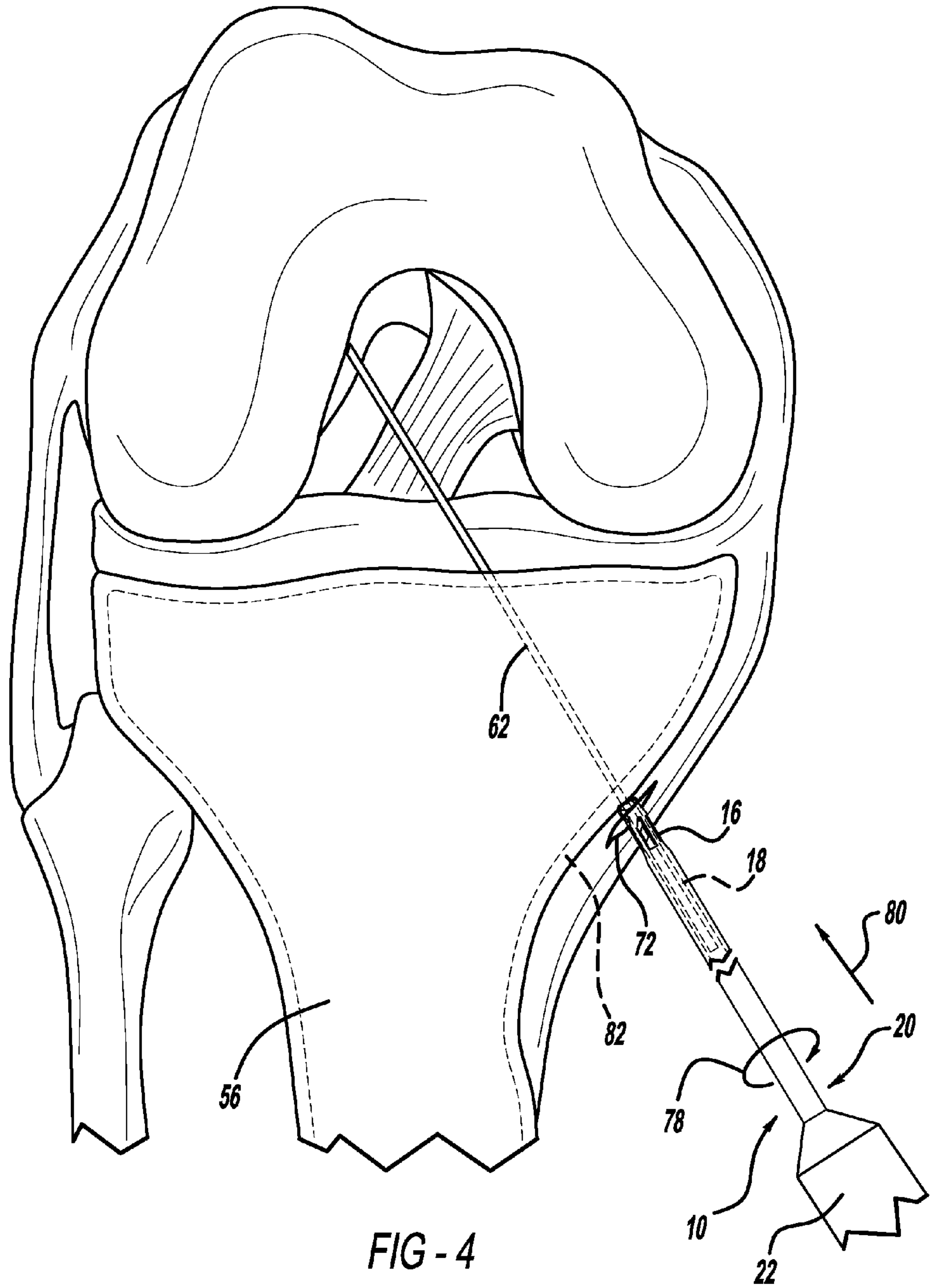


FIG - 4

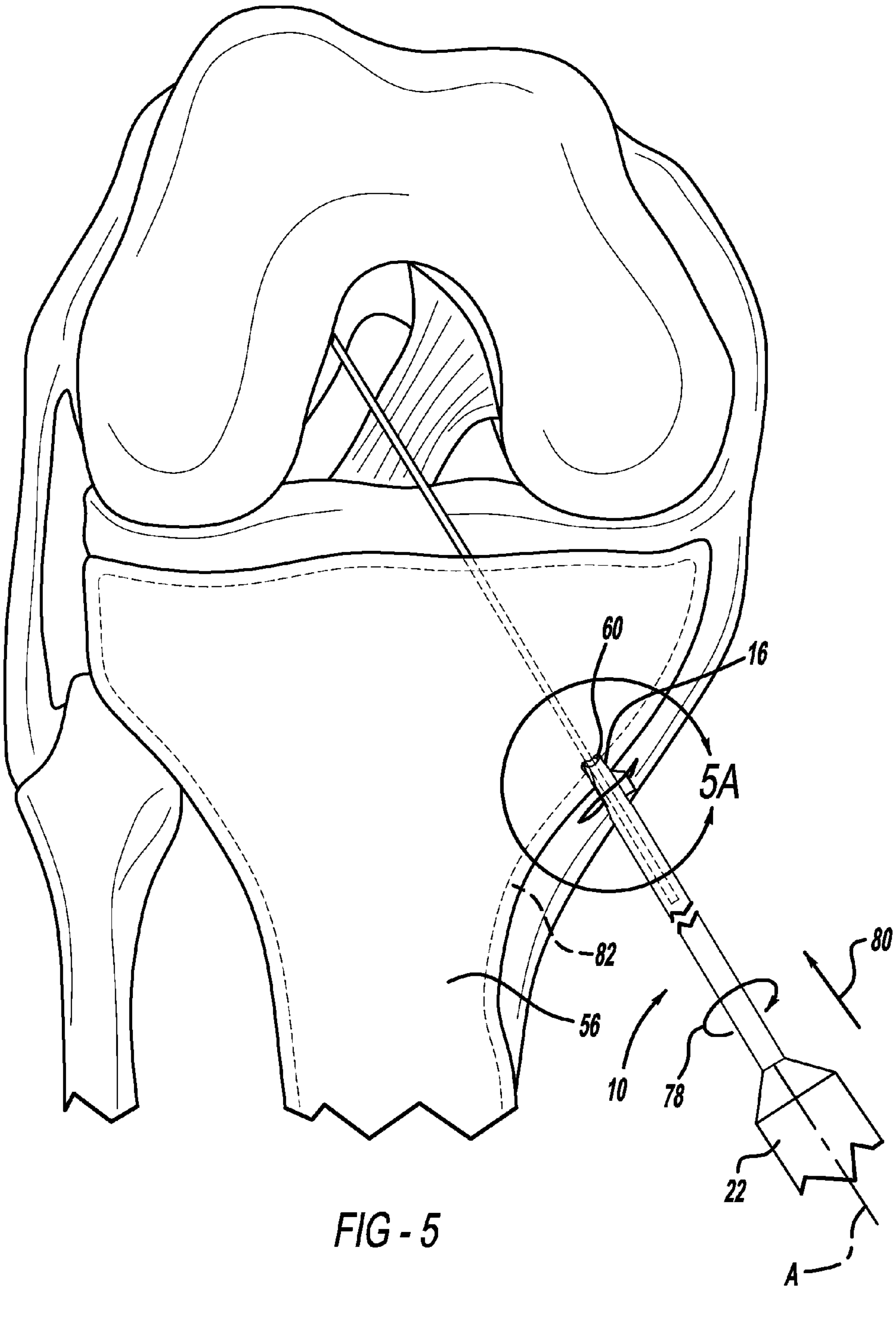


FIG - 5

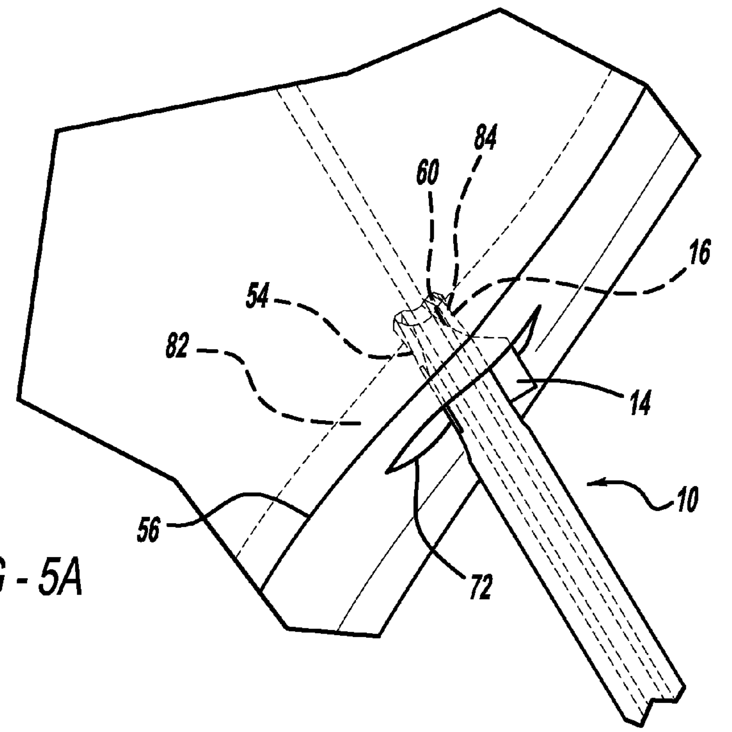


FIG - 5A

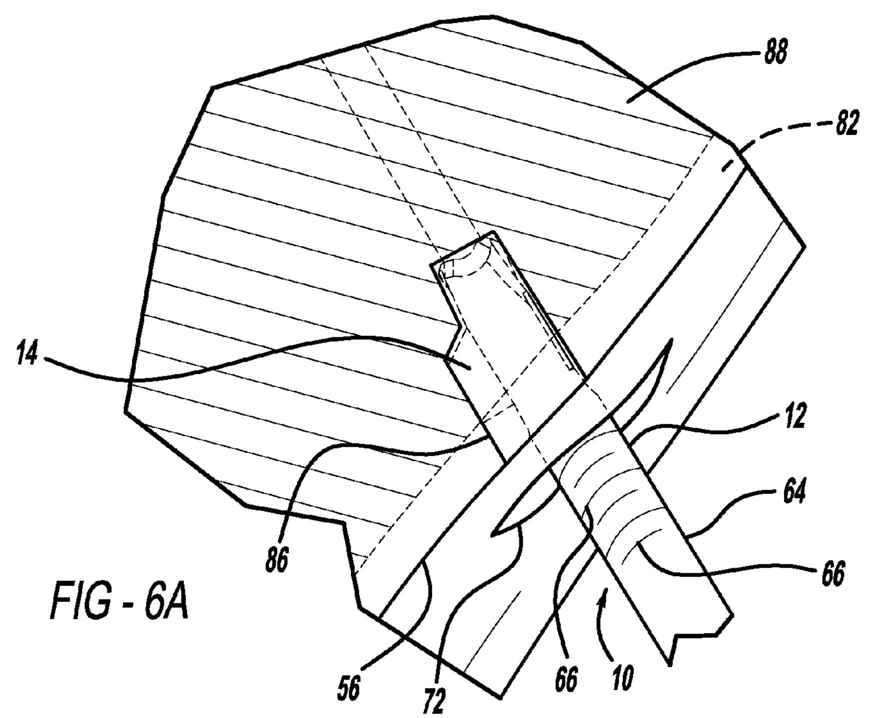


FIG - 6A

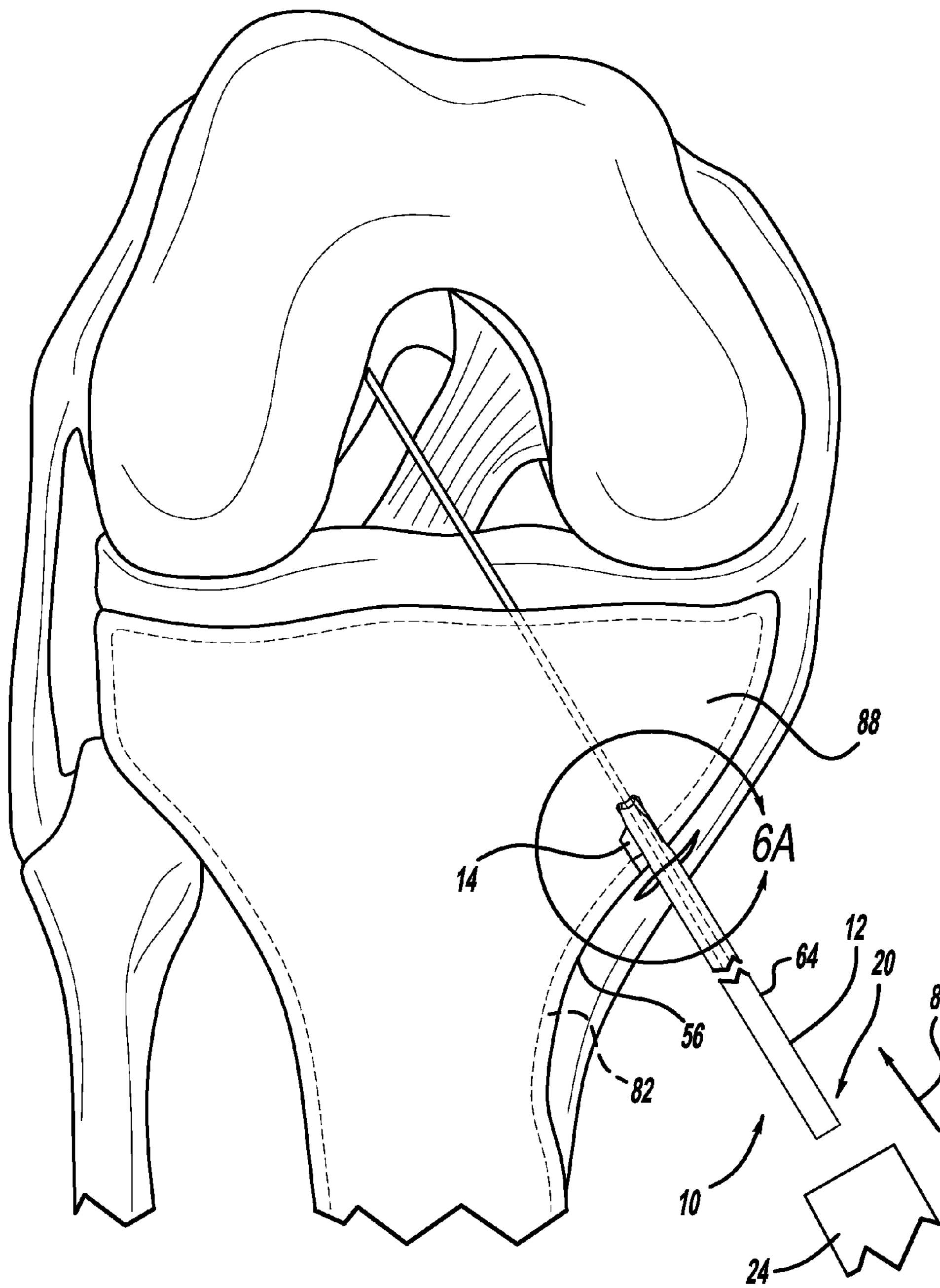


FIG - 6

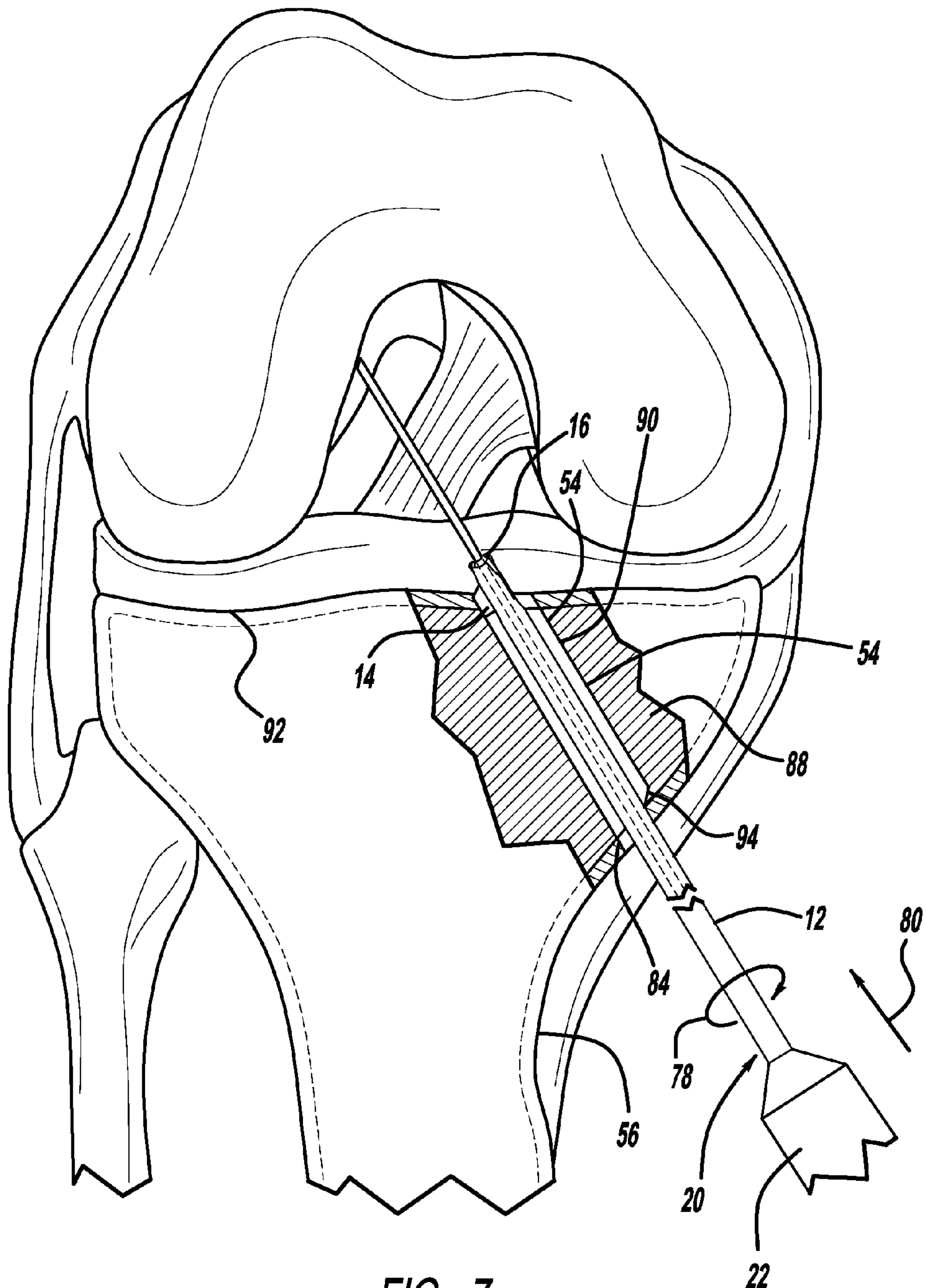


FIG - 7

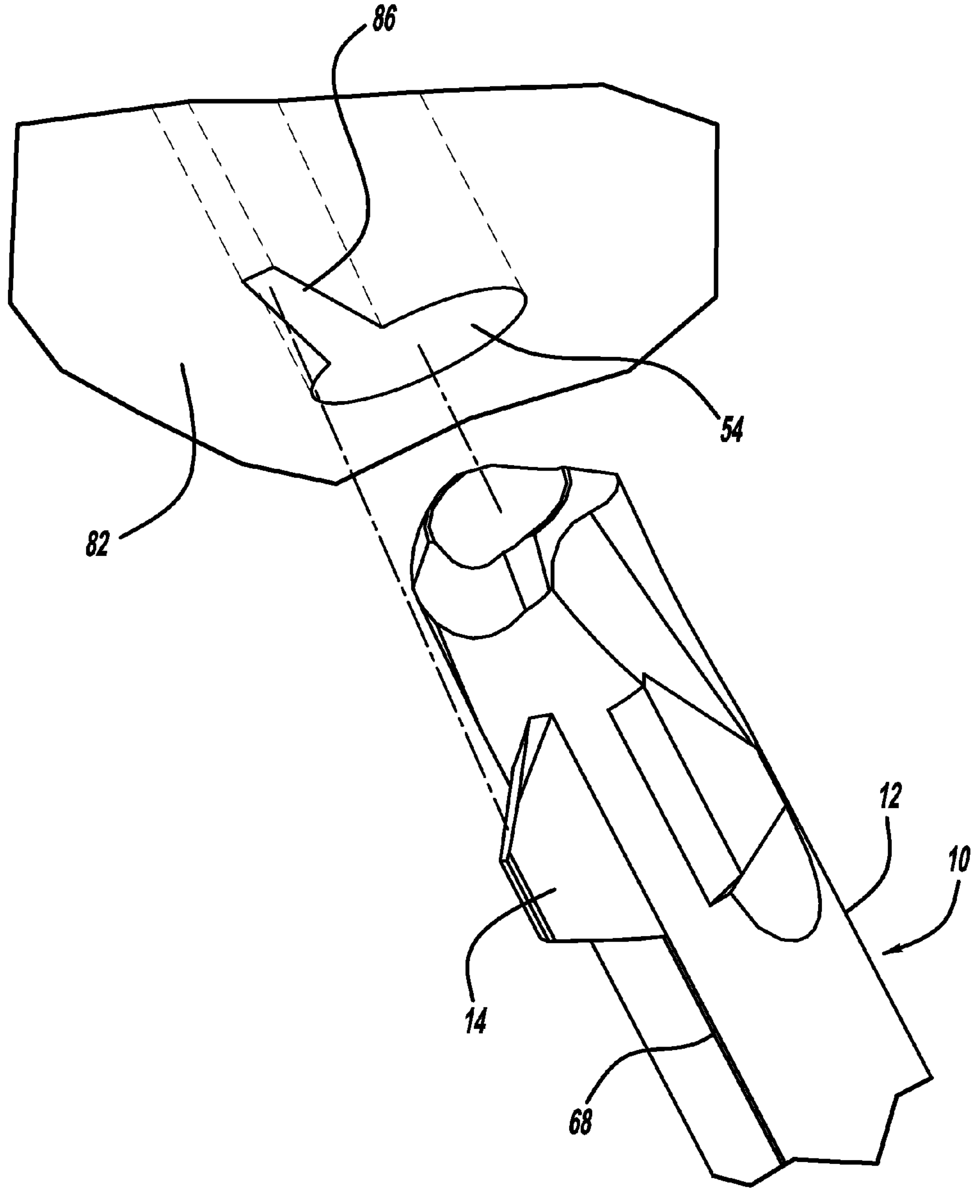


FIG - 8

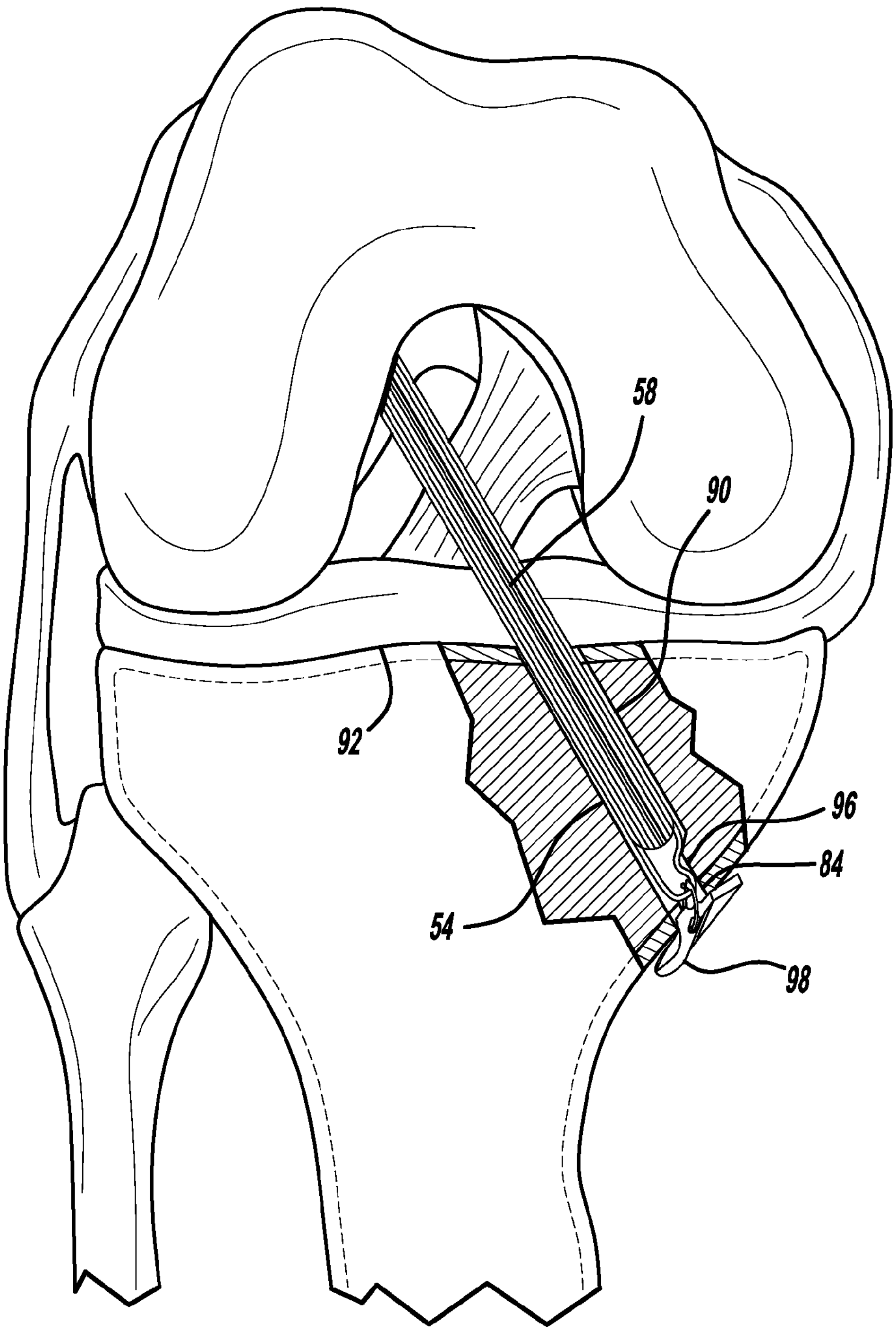


FIG - 9

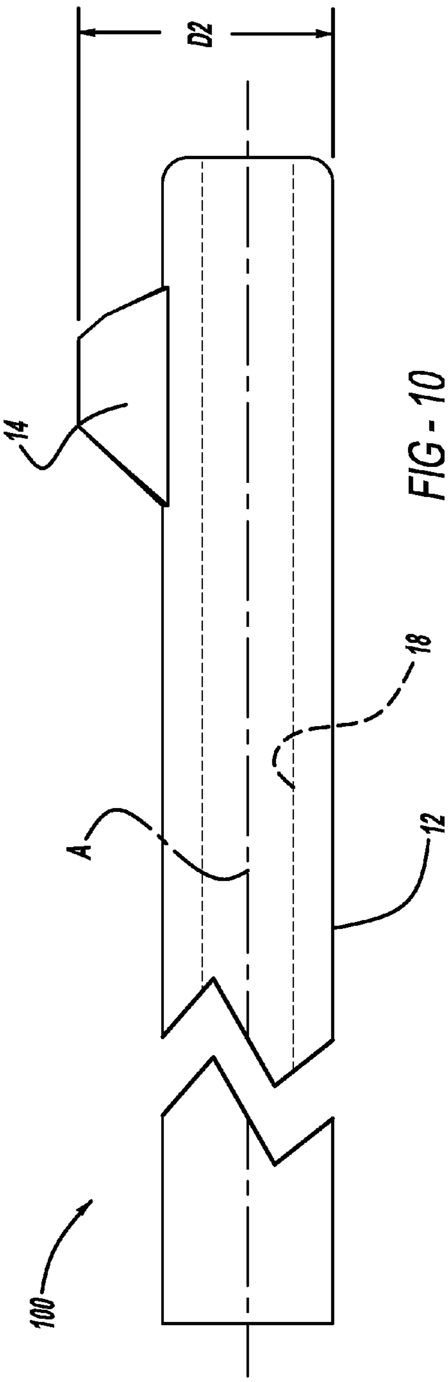


FIG - 10

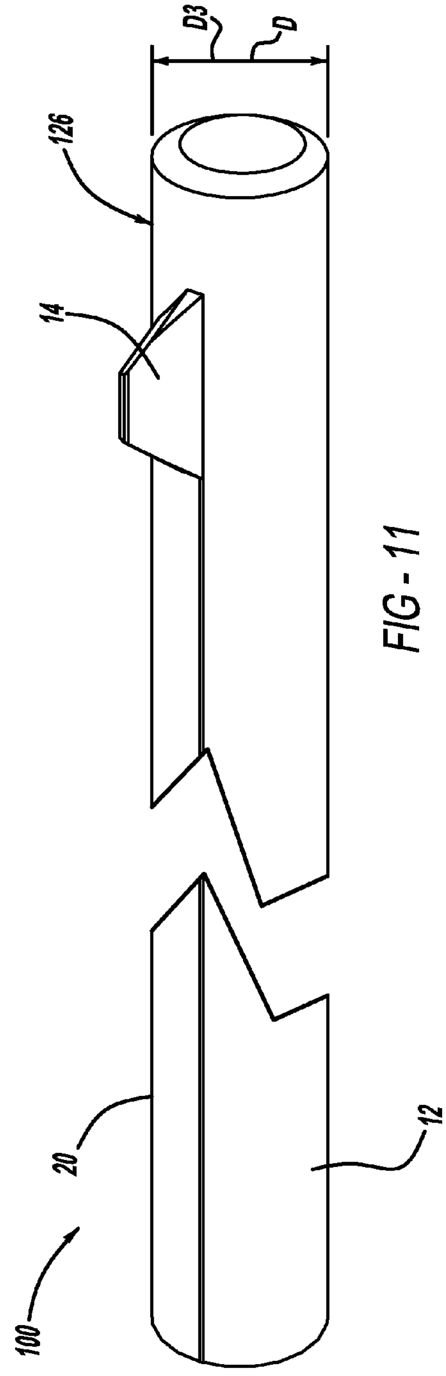


FIG - 11

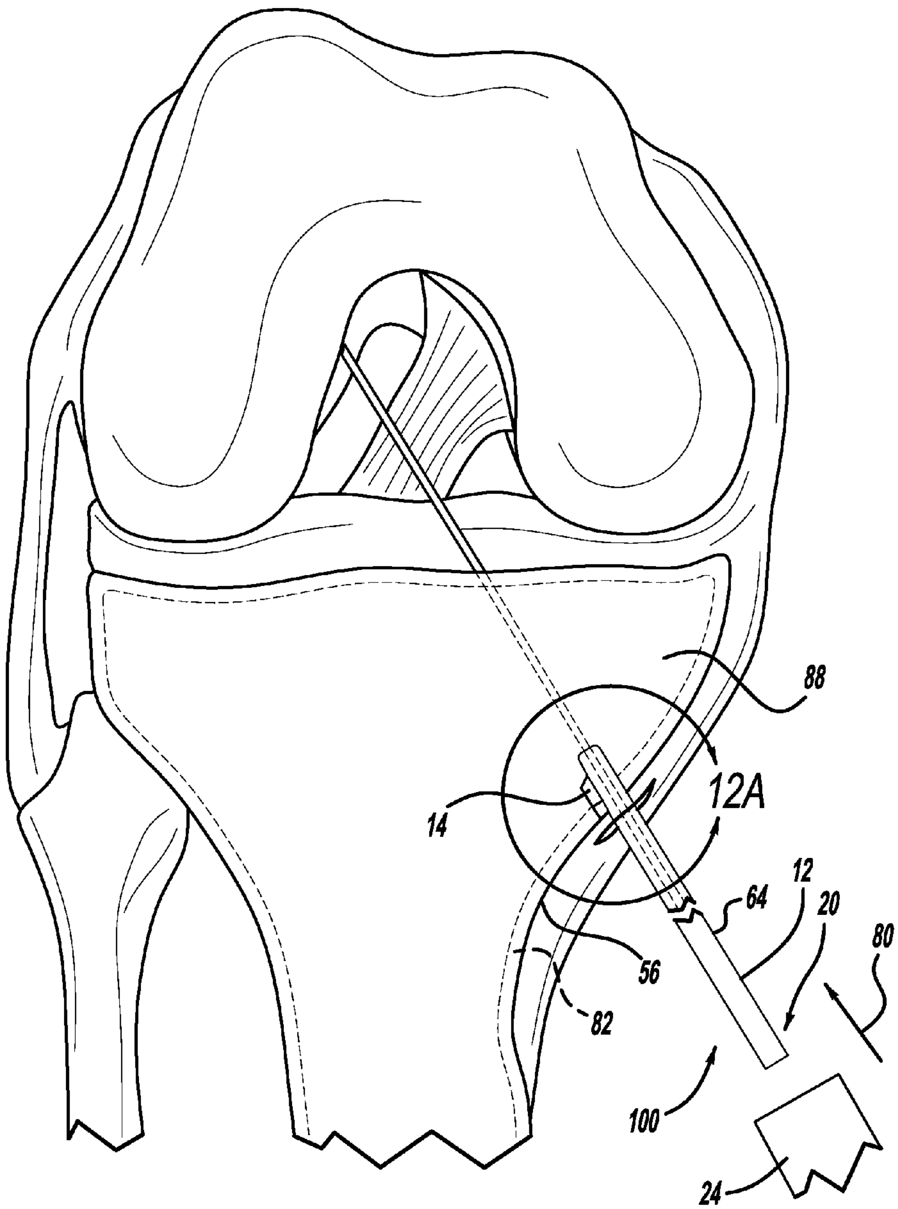


FIG - 12

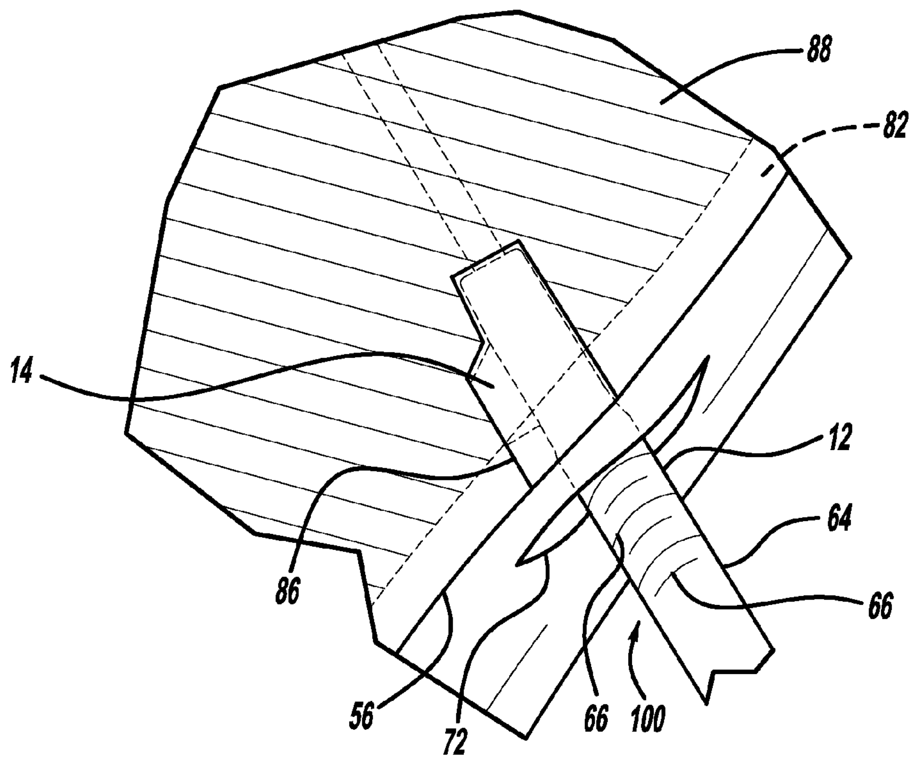


FIG - 12A

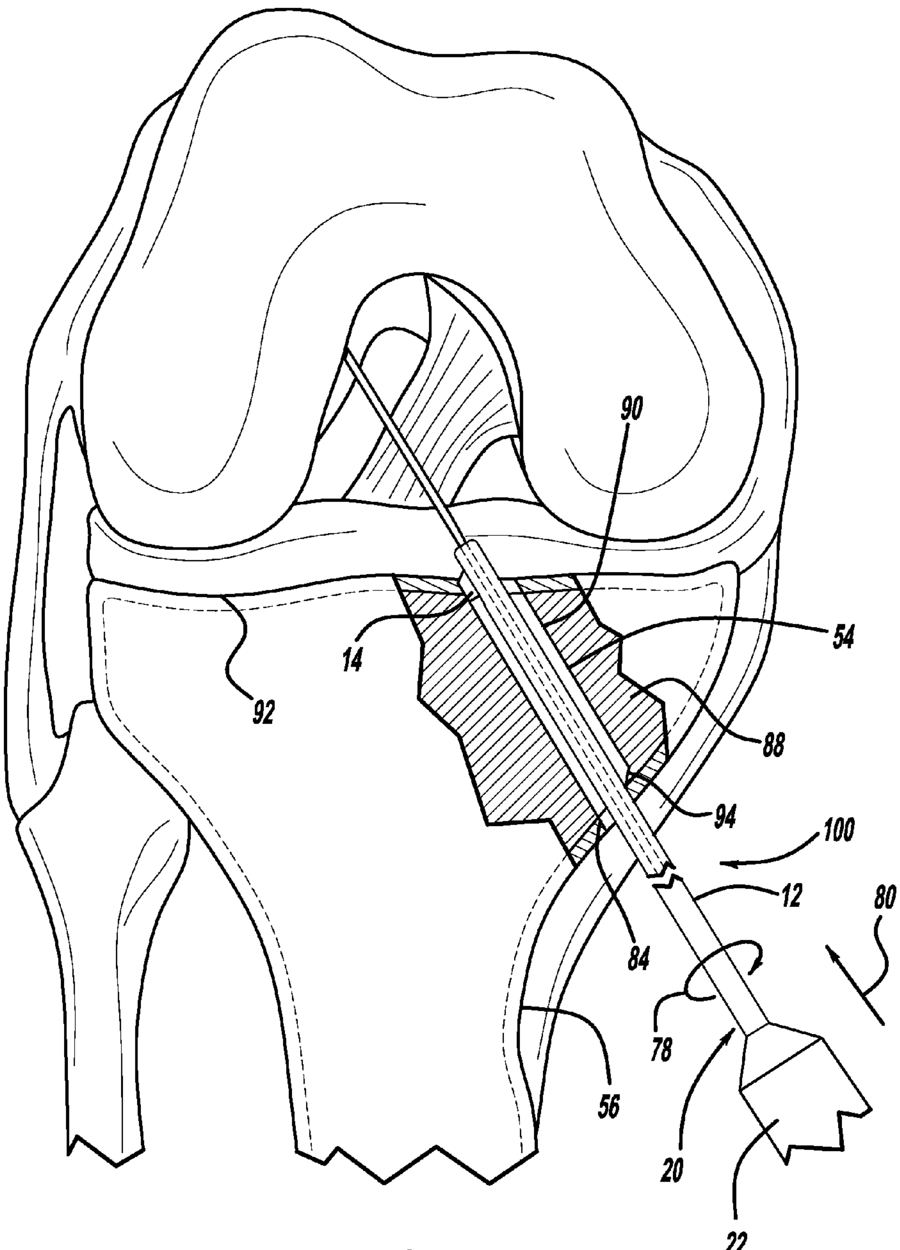


FIG - 13

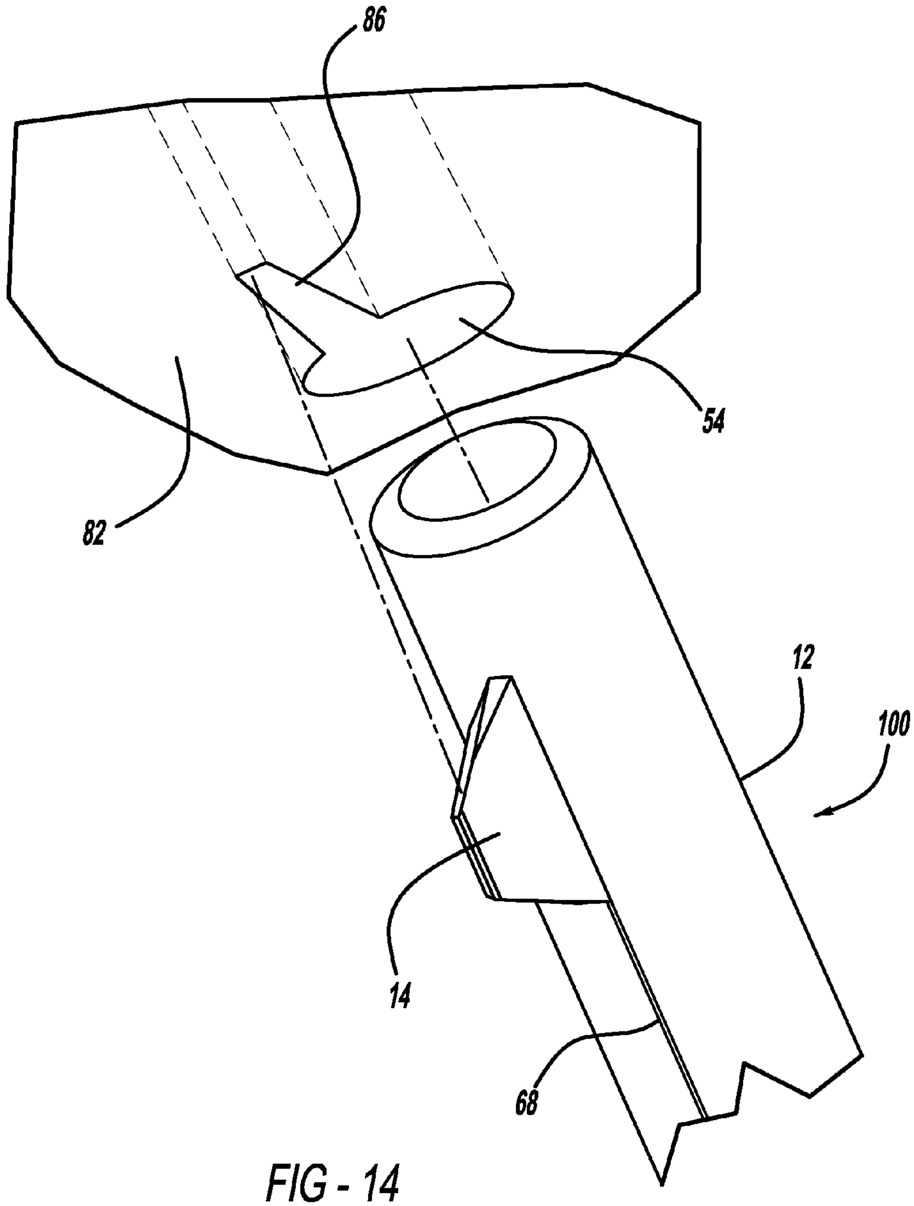


FIG - 14

# METHOD AND APPARATUS FOR FORMING A HOLE IN BONE DURING A SURGICAL PROCEDURE

## FIELD

The present disclosure relates generally to orthopedic procedures; and relates particularly to a method and an apparatus for forming a hole in a bone for tissue fixation.

## BACKGROUND

This section provides background information related to the present disclosure which is not necessarily prior art.

In an anatomy, such as a human anatomy, various soft tissue portions are interconnected with various bony portions. For example, a tendon may interconnect a selected muscle group with a selected portion of the anatomy. Similarly, a ligament may interconnect two bony portions. For example, the anterior cruciate ligament (ACL) interconnects a portion of the tibia with a portion of the femur. Although natural and healthy ligaments, tendons, and other selected soft tissues are generally able to support the various portions of the anatomy, injury, age, or other circumstances may cause the weakening or tearing of these various soft tissue portions. In particular, injury or disease may weaken various soft tissue portions, requiring the tissue to be reconnected or replaced with various autografts or xenografts. These various materials may be interconnected with selected portions of the anatomy using various anchoring devices implanted within a bore formed in the bone.

## SUMMARY

This section provides a general summary of the disclosure, and is not a comprehensive disclosure of its full scope or all of its features.

In one form, the present disclosure provides a method for forming a hole in a bone. The method includes bringing a bone cutting tool extending along a longitudinal axis into engagement with a cortical portion of the bone. A distal portion of the bone cutting tool is passed into the cortical portion of the bone up to a first predetermined depth to form a first bore. The bone cutting tool is then driven in the axial direction to a second predetermined depth to form a keyway portion in the first bore with a cutting tooth of the bone cutting tool. The bone cutting tool is then rotated about the longitudinal axis to form a second bore in a cancellous portion of the bone. The first bore and the second bore have a shoulder extending therebetween. The bone cutting tool is removed from the hole formed by the first and second bores in the bone.

In another form, the present disclosure provides a method for forming a hole in a bone. The method includes bringing a bone cutting tool into engagement with an outer surface of the bone. A distal portion of the bone cutting tool is then rotated about a longitudinal axis while driving a fluted tip of the bone cutting tool into a cortical portion of the bone up to a first predetermined depth to form a first bore extending from the outer surface of the bone. The bone cutting tool is driven in an axial direction to a second predetermined depth to form a keyway radially extending from the first bore and through the cortical portion of the bone with a cutting tooth of the bone cutting tool. The bone cutting tool is then rotated to form a second bore in a cancellous portion of the bone, the first bore and the second bore having a shoulder extending therebetween. Next a marking line on the bone cutting tool is aligned with the keyway and the bone cutting tool is removed from the



hole formed by the first and second bores while the marking line is aligned with the keyway. A repair tissue is then inserted into the second bore with a fixation device positioned relative to the first bore for retaining the repair tissue in the second bore.

In yet another form, the present disclosure provides a bone cutting tool having a shaft portion extending from a proximal end to a distal end along a central longitudinal axis. The shaft portion defines a through bore extending from the proximal end to the distal end of the shaft portion. The through bore is coaxially aligned with the shaft portion. A cutting tooth radially extends from the shaft portion near the distal end. Furthermore, the cutting tooth has a sharpened first edge for axial movement into a cortex of a bone and a sharpened apex for rotational movement through a cancellate of a bone.

Further areas of applicability will become apparent from the description provided herein. The description and specific examples in this summary are intended for purposes of illustration only and are not intended to limit the scope of the present disclosure.

## DRAWINGS

The drawings described herein are for illustrative purposes only of selected embodiments and not all possible implementations, and are not intended to limit the scope of the present disclosure.

FIG. **1** is a side view of a bone cutting device constructed in accordance with the teachings of the present disclosure;

FIG. **2**A is a perspective view of the bone cutting device of FIG. **1**;

FIG. **2**B is an end view of the bone cutting device of FIG. **1**;

FIG. **3** is a perspective view of an aimer in association with a bone of a body;

FIG. **4** is a perspective view of the bone cutting device of FIG. **1** in an initial operative position in association with the bone of the body;

FIGS. **5** through **7** are perspective views of the bone cutting device of FIG. **1** in intermediate operative positions with respect to the bone of the body;

FIG. **8** is a perspective view of the bone cutting device of FIG. **1** being removed from the bone of the body;

FIG. **9** is a cross-sectional view of a bone socket established by the bone cutting device of FIG. **1** incorporating a tissue;

FIG. **10** is a side view of an alternate bone cutting device constructed in accordance with the teachings of the present disclosure;

FIG. **11** is a perspective view of the bone cutting device of FIG. **10**; and

FIGS. **12** through **14** are perspective views of the bone cutting device of FIG. **10** in intermediate operative positions with respect to the bone of the body.

Corresponding reference numerals indicate corresponding parts throughout the several views of the drawings.

## DETAILED DESCRIPTION

The following description of various embodiments is merely exemplary in nature and is not intended to limit the present disclosure, its application, or uses. It should be understood that throughout the drawings, corresponding reference numerals indicate like or corresponding parts and features. With reference to FIGS. **1-14**, various methods and apparatuses are disclosed for providing a hole in a bone during an anterior cruciate ligament (ACL) procedure. However, the methods and apparatuses may also be used for a plurality of surgical procedures where a bone hole is required, such as in a hamstring repair, an Achilles tendon allograft, or other soft tissue repair. In addition, although a toggle anchor is shown for the tissue fixation, it will be understood that any securing member may be situated in a bone bore formed by the apparatuses. Furthermore, the replacement of a tendon or a ligament is not necessarily a requirement of the following apparatuses or methods. The apparatuses and methods may also be augmented to provide for various or similar procedures without being outside of the scope of the following description and the appended claims. Therefore, it will be understood that the following discussions are not intended to limit the scope of the present teachings or claims herein.

Referring now to FIGS. **1**, **2**A, and **2**B of the drawings, a cannulated bone cutting tool is generally indicated by reference number **10**. The cannulated bone cutting tool **10** is shown to include an elongated body or shaft **12**, at least one flag or cutting tooth **14**, a fluted end **16**, and a longitudinally extending bore **18**. The shaft **12** can include a first, proximal end **20** configured for receipt by a driving device. For example, the driving device may be a handle (not shown), a chuck of a power driver **22** (FIG. **4**), or a mallet **24** (FIG. **6**), as will be described in more detail below. The shaft **12** can also include an opposite second, distal end **26** having the cutting tooth **14** and terminating at the fluted end **16**. The shaft **12** extends along an axis, A, and is configured to have a constant diameter, D, over its length (e.g., 4.5 mm). Alternately, the shaft **12** may have a varied diameter so as to form an integral shoulder portion (not shown) at the proximal end **20** for receiving the driving device.

It should be understood that the bone cutting tool **10** may be formed of any rigid material. For example, various biocompatible metals may be used that may be easily formed and sharpened to form the fluted end **16**. Various alternatives may also include ceramics and polymers. It should also be understood that only the distal end **26** may be formed from a rigid material. In such a case, the proximal end **20** of the shaft **12** may be formed from any flexible material known in the art and typically used for maneuvering in minimally invasive surgeries (i.e., arthroscopic surgery for replacing an ACL).

The cutting tooth **14** may be coupled to the shaft **12** and extend radially outwardly therefrom by a predetermined distance **28** (e.g., 1-5 mm) and over a predetermined length **30** (e.g., 4-10 mm). The cutting tooth **14** can be formed by machining the distal end **26** of the shaft **12** or otherwise connecting the cutting tooth **14** to the distal end **26** (e.g., welding). The cutting tooth **14** may be located proximally a depth **32** (e.g., 2-10 mm) from a distal most end **34** of the fluted end **16**. The depth **32** may correspond to a depth necessary for allowing the bone cutting tool **10** to pierce through cortical bone, while maintaining the cutting tooth **14** against an external surface of the bone, as will be described in more detail below.

Furthermore, the cutting tooth **14** may be generally pyramidal in shape so as to have a pair of opposing faces **36**, **38** beginning at a base **40** and tapering towards an apex **42** of the cutting tooth **14**. The apex **42** of the cutting tooth **14** may have a faceted surface **44** so as to provide a rotational cutting edge for the cutting tooth **14**. For example, the faceted surface **44** may be provided at an angle, $\alpha$, with respect to a plane extending longitudinally through the shaft **12**, as best shown in FIG. **2**B.

The cutting tooth **14** may also have an angled trailing edge **46** at an angle, $\beta$, with respect to the plane through the shaft **12**, and a faceted lead cutting edge **48** having a first, lower portion **50** at an angle, $\gamma$, with respect to the shaft **12**, and a second, upper portion **52** at an angle, $\Delta$, with respect to the shaft **12**. The angle, $\beta$, of the trailing edge **46** allows for minimal resistance during removal of the bone cutting tool **10** from the bone, while the angles, $\gamma$ and $\Delta$, of the faceted lead cutting edge **48** provide an axial cutting edge for the cutting tooth **14** as the bone cutting tool **10** is being driven axially into bone, as will be described in more detail below. Nevertheless, it will be understood that the cutting tooth **14** may be any appropriate shape, such as generally rectangular and include portions that are fluted to provide an alternative cutting mode for the instrument and to remove the least amount of bone.

Rotation of the cutting tooth **14** (as shown in phantom in FIG. **1**) may provide a second diameter, D**2**, of the cannulated bone cutting tool **10**, which is larger than the first diameter, D, of the shaft **12**. Furthermore, the distance **28** and length **30** can be varied to provide an appropriately dimensioned hole **54** in a bone (e.g., tibia **56**) for receipt of a repair tissue **58** (see FIG. **9**), as will be described in more detail below. Additionally, the depth **32** of the cutting tooth **14** from the distal most end **34** may vary for establishing the location of the bone hole **54** in portions of the body where the thickness of the cortex varies. In other words, as the depth **32** is a depth designed to penetrate greater than the cortical depth, a plurality of tools may be provided to accommodate different cortical depths. This cortical depth may be determined by x-ray or other previously obtained knowledge.

Bone cutting can also be initiated through the fluted end **16**. The fluted end **16** can include a plurality of cutting edges or flutes **60**. In the exemplary configuration shown, the cannulated bone cutting tool **10** includes two flutes **60**, but any number of flutes **60** is contemplated. The flutes **60** can extend from the distal most end **34** of the shaft **12** so as to provide a path for removed bone material to exit during use.

The cannulated bone cutting tool **10** can also include the longitudinal bore **18** extending from the proximal end **20** to the distal end **26** of the shaft **12** for receipt of a guide wire **62** (FIG. **3**). The longitudinal bore **18** has an axis coinciding with the axis, A. Furthermore, the longitudinal bore **18** may be open at the distal most end **34** and appropriately sized (e.g., 2.5 mm) in order to allow the guide wire **62** to pass therethrough, as will be described in more detail below.

An exterior surface **64** of the shaft **12** may include a plurality of demarcations **66** (FIG. **6**A) indicating an appropriate scale. For example, the markings **66** may be included at approximately 10 mm intervals extending axially such that markings at 10, 20, 30, 40, etc mm are provided on the exterior surface **64** of the shaft **12**. A user may view the markings **66** on the exterior surface **64** of the shaft **12** to determine the depth of the bone cutting tool **10** within the selected bone. Furthermore, an axial line **68** may be etched or lasered onto the exterior surface **64** as to align with the cutting tooth **14**. The laser line **68** may extend from the base **40** of the cutting tooth **14** to the proximal end **20** of the shaft **12** for assisting a surgeon in aligning and removing the bone cutting tool **10** from the bone after surgery (FIG. **8**).

Referring now to FIGS. **3**-**9**, the foregoing cannulated bone cutting tool **10** may be used to form a blind bore, concavity, or the bone hole **54** during an anterior cruciate ligament (ACL) reconstruction. As discussed above, the ACL reconstruction is simply exemplary as the general process described herein can be used to provide the bone hole **54** in any selected portion of the anatomy, such as in a femur, humerus, or any other appropriate bone portion. In addition, the bone hole **54** may be formed for any selected procedure and not simply an ACL reconstruction. However, this bone cutting tool **10** provides additional benefits in the ACL reconstruction, as it provides an enlarged hole within the tibia **56** for receipt of the repair tissue **58**, but still only allows a minimal amount of cortex removed (e.g., for ease in healing and for reduced pain to a patient).

With particular reference to FIG. **3**, a selected knee joint **70** can be first prepared for the ACL procedure. First, an incision **72** may be formed in a soft tissue **74** surrounding the knee joint **70**. After the incision **72** is formed, an aimer **76** may be used to guide the guide wire **62** through a selected portion of the tibia **56**. Appropriate aimers **76** are generally known and need not be described in detail herein. Also, other techniques for placing the guide wire **62** in the tibia **56** are also generally known and not described in detail herein. For example, such a device and method is described in U.S. Pat. No. 7,736,364, Stone, issued Jun. 15, 2010, and is incorporated by reference in its entirety herein. It will also be understood that the incision **72** may be any appropriate size, but is generally between about 1 cm to about 10 cm. Therefore, the procedure may be augmented with an arthroscope (not shown) that is either passed through the incision **72** or other appropriate incisions.

Referring now to FIG. **4**, the longitudinal bore **18** of the cannulated bone cutting tool **10** can be passed over the guide wire **62** to guide the bone cutting tool **10** as it is brought into engagement with the tibia **56**. In certain embodiments, the driver **22** may be engaged with the proximal end **20** of the bone cutting tool **10** before passing over the guide wire **62**. However, the driver **22** may also be fixed to the proximal end **20** after the bone cutting tool **10** is passed through the incision **72** and placed into alignment with the tibia **56**. In either case, the driver **22** may be any device that imparts both a rotational (as shown by arrow **78**) and an axial force (as shown by arrow **80**) to the bone cutting tool **10**. The fluted end **16** of the bone cutting tool **10** is first positioned relative an anterior cortical portion **82** of the tibia **56**. Accordingly, a reduced size hole may be formed through the cortical portion **82** of the tibia **56**.

With reference now to FIGS. **5** and **5**A, the bone cutting tool **10** may now be rotated around longitudinal axis, A, in the rotational direction **78** by manipulation of the driver **22**. The driver **22** may impart the rotational and axial forces **78**, **80** so as to gradually pierce the flutes **60** of the fluted end **16** into and through the cortical portion **82** of the tibia **56**. This inward rotation establishes a first cylindrical portion **84** of the bone hole **54** having a diameter correspondingly sized with the diameter, D, of the shaft **12**. The driver **22** continues to rotate the bone cutting tool **10** and remove material from the bone hole **54** until the cutting tooth **14** is aligned with the outer anterior cortex of the tibia **56**. In other words, the rotational and axial movement of the driver **22** moves the flutes **60** through the cortical portion **82** of the tibia **56**, which brings the cutting tooth **14** into alignment with the outer surface of the tibial cortex.

Referring now to FIGS. **6** and **6**A, the driver **22** may be decoupled from the bone cutting tool **10**, while keeping the bone cutting tool **10** aligned with the tibia **56**. The mallet **24**, or any other appropriate instrument, may then be used to strike the proximal end **20** of the shaft **12** in the axial direction **80**. The bone cutting tool **10** may be struck several times to non-rotationally drive the lead cutting edge **48** of the cutting tooth **14** axially into and through the cortical portion **82** of the tibia **56** in order to create a keyway **86**.

As discussed above, the markings **66** on the exterior surface **64** of the shaft **12** may be used to determine the depth to which the bone cutting tool **10** has penetrated the tibia **56**. The markings **66** may be viewed either through the incision **72** or through a selected arthroscope or other viewing instrument. After the bone cutting tool **10** has passed the selected distance into the tibia **56** (e.g., the cutting tooth **14** is completely within a cancellous portion **88** of the tibia **56**), the driver **22** may be reattached to the bone cutting tool **10**.

After reattachment of the driver **22** as shown in FIG. **7**, the fluted end **16** and the cutting tooth **14** of the bone cutting tool **10** are positioned relative the cancellous portion **88** of the tibia **56**. The driver **22** may again impart the rotational and axial forces **78**, **80** to the bone cutting tool **10** through the proximal end **20** of the shaft **12**. The driver **22** rotationally drives the flutes **60** of the fluted end **16** and the cutting tooth **14** of the bone cutting tool **10** through the cancellous portion **88** of the tibia **56** to establish a second portion **90** of the bone hole **54**. Notably, the second portion **90** of the bone hole **54** may have a diameter correspondingly sized with the diameter, D2, of the rotational cutting tooth **14**. The driver **22** continues to rotate the bone cutting tool **10** and remove material from the bone hole **54** until the bone cutting tool **10** rotates and extends through a tibial plateau **92** of the tibia **56**. In this way, the cortical portion **82** of the tibia **56** has a minimal amount of bone material removed, while the second portion **90** is enlarged for receipt of the repair tissue **58** within the cancellous portion **88** of the tibia **56**. It should be understood, however, that the cortex at the tibial plateau **92** is bored to a similar diameter as the second portion **90**.

In order to remove the bone cutting tool **10** from the tibia **56** without removing further amounts of the cortical portion **82**, the laser line **68** on the shaft **12** is rotated into alignment with the keyway **86** or slot formed into the cortex (FIG. **8**). The bone cutting tool **10** may then be axially removed from the first and second portions **84**, **90** of the bone hole **54**. In this way, the bone hole **54** may have a minimal amount of bone material removed from the cortical portion **82** of the tibia **56**, allowing the surgeon to prepare a socket for a graft without violating the tibial wall with a large diameter hole. As previously discussed, the first portion **84** of the bone hole **54** is correspondingly sized with the diameter, D2, of the rotational cutting tooth **14** and the second portion **90** is correspondingly sized with the diameter, D, of the shaft **12** creating a shoulder **94** within the bone hole **54**.

With reference now to FIG. **9**, the bone hole **54** is sized to receive a tissue fixation device, such as a toggle anchor **96**. It should be understood that while one exemplary tissue fixation device is described herein, other tissue anchoring devices are contemplated. For example, soft anchors having a single suture extending therethrough or rigid anchors may be used. The toggle anchor **96** can be preassembled to include a looped configuration joined with the repair tissue **58**, as described in U.S. Patent Publication No. 2009/0054928, Denham et al., published Feb. 26, 2009, and incorporated herein by reference in its entirety. In one example as shown herein, the toggle anchor **96** may be passed through the tibial plateau **92** into the first portion **84** of the bone hole **54**. A toggle **98** may extend through the second portion **90** of the bone hole **54** so as to engage the outer anterior cortical portion **82** of the tibia **56**. In this way, the toggle **98** may be maintained outside the second portion **90** of the bone hole **54**, while the repair tissue **58** is drawn into the first portion **84** of the bone hole **54**.

With reference now to FIGS. **10** and **11**, another exemplary bone cutting tool **100** is provided. The bone cutting tool **100** is similar to the bone cutting tool **10**, as the bone cutting tool **100** is also operable for preparing the tibia **56** for receipt of the repair tissue **58**. Because many features of the bone cutting tool **100** are similar to those described with reference to the cannulated bone cutting tool **10**, a detailed description of these elements is forgone. Furthermore, like reference numerals are used to describe like elements.

The bone cutting tool **100** is shown to include the elongated shaft **12**, the cutting tooth **14**, and the longitudinally extending bore **18**. The shaft **12** may be configured for receipt of the driving device (e.g., driver **22**, mallet **24**) at the proximal end **20** and have the cutting tooth **14** at a distal end **126**, as previously described with respect to the bone cutting tool **10**. Furthermore, the bore **18** may also extend through the distal end **126** of the shaft **12** for receipt of the guide wire **62** (FIG. **3**). The bone cutting tool **100**, however, omits the flutes **60** at the distal end **126**. In particular, the distal end **126** has a diameter, D**3**, that corresponds to the diameter, D, of the shaft **12**. As such, the first portion **84** of the bone hole **54** may be pre-drilled for receipt of the bone cutting tool **100** in the cortical portion **82** of the tibia **56** on impact.

In particular, after placement of the guide wire **62** as shown in FIG. **3**, a cannulated drill bit (not shown) may be placed over the guide wire **62** and rotated to pass through the cortical portion **82** of the tibia **56**. The cortical portion **82** removed may have a diameter equivalent to the shaft **12** of the bone cutting tool **100**. After removal of the cortical portion **82**, the drill bit is removed and replaced with the bone cutting tool **100**.

With reference now to FIGS. **12** and **12**A, the mallet **24** may then be used to strike the proximal end **20** of the shaft **12** to drive the bone cutting tool **100** and, in particular, the lead cutting edge **48** of the cutting tooth **14** into and through the cortical portion **82** of the tibia **56** to the selected depth completely within the cancellous portion **88** of the tibia **56**. In the process, the keyway **86** or slot is formed.

The driver **22** may then be attached to the bone cutting tool **100** for imparting the rotational and axial forces **78**, **80** to the bone cutting tool **100** through the proximal end **20** of the shaft **12**, as shown in FIG. **13**. The driver **22** rotationally drives the cutting tooth **14** of the bone cutting tool **100** through the cancellous portion **88** of the tibia **56** to establish the second portion **90** of the bone hole **54** until the bone cutting tool **100** extends through the tibial plateau **92** of the tibia **56**. The laser line **68** on the shaft **12** of bone cutting tool **100** is then rotated into alignment with the keyway **86**, for removal therefrom (FIG. **14**). As previously discussed, the first portion **84** of the bone hole **54** is correspondingly sized with the diameter, D**2**, of the rotational cutting tooth **14** and the second portion **90** is correspondingly sized with the diameter, D**3**, of the distal end **126** creating the shoulder **94** within the bone hole **54**.

The foregoing description of the embodiments has been provided for purposes of illustration and description. It is not intended to be exhaustive or to limit the disclosure. Individual elements or features of a particular embodiment are generally not limited to that particular embodiment, but, where applicable, are interchangeable and can be used in a selected embodiment, even if not specifically shown or described. The same may also be varied in many ways. Such variations are not to be regarded as a departure from the disclosure, and all such modifications are intended to be included within the scope of the disclosure.

What is claimed is:

**1**. A method for forming a hole in a bone, the method comprising:

bringing a bone cutting tool that extends along a longitudinal axis into engagement with a cortical portion of the bone, the bone cutting tool having a cutting tooth spaced a distance away from a distal-most end of the cutting tool;

passing a distal portion of the bone cutting tool into the cortical portion of the bone up to a first predetermined depth to form a first bore;

driving without rotating the bone cutting tool in an axial direction to a second predetermined depth to form an elongated keyway slot extending radially from and along a longitudinal portion of the first bore with the cutting tooth of the bone cutting tool;

rotating the bone cutting tool about the longitudinal axis to form a second bore deeper than the first bore in a cancellous portion of the bone, the first bore and the second bore having a shoulder extending therebetween; and

removing the bone cutting tool from the hole formed by the first and second bores in the bone.

**2**. The method of claim **1**, further comprising:

inserting a repair tissue into the second bore; and

positioning a fixation device through the first bore to retain the repair tissue in the second bore.

**3**. The method of claim **2**, wherein the bone cutting tool is brought into engagement with an anterior cortical portion of a tibia to form the hole in the tibia.

**4**. The method of claim **3**, wherein inserting the repair tissue includes inserting an anterior cruciate ligament graft into the hole formed in the tibia.

**5**. The method of claim **1**, wherein passing the distal portion of the bone cutting tool into the cortical portion of the bone further includes:

rotating the bone cutting tool about the longitudinal axis while driving a fluted tip of the bone cutting tool through the cortical portion of the bone to the cancellous portion of the bone to form the first bore, where the first predetermined depth is greater than the depth of the cortical portion of the bone.

**6**. The method of claim **1**, wherein rotating the bone cutting tool about the longitudinal axis is performed with a driver attached to a proximal end of the bone cutting tool, the method further comprising:

removing the driver from the proximal end of the bone cutting tool;

striking the proximal end of the bone cutting tool to drive the bone cutting tool in the axial direction to the second predetermined depth; and

reattaching the driver to the proximal end of the bone cutting tool for rotating the bone cutting tool about the longitudinal axis to form the second bore through the cancellous portion of the bone.

**7**. The method of claim **1**, further comprising:

aligning a line on the bone cutting tool that extends from the cutting tooth with the keyway slot before removing the bone cutting tool from the bone; and

removing the bone cutting tool from the hole while the line is aligned along the keyway slot.

**8**. The method of claim **1**, wherein passing the distal portion of the bone cutting tool into the cortical portion of the bone further includes:

pre-drilling the cortical portion of the bone up to the first predetermined depth for axially receiving the distal portion of the bone cutting tool.

**9**. The method of claim **1**, wherein forming the first bore and the second bore includes forming the first bore having a first diameter and forming the second bore having a second diameter, where the first diameter is less than the second diameter.

**10**. The method of claim **1**, further comprising:

guiding the bone cutting tool over a guide wire positioned in the bone.

**11**. A method for forming a hole in a bone, the method comprising:

bringing a bone cutting tool into engagement with an outer surface of the bone, the bone cutting tool having a distal portion with a fluted tip and a cutting tooth proximally to the fluted tip and spaced a distance away from a distal-most end of the fluted tip;

rotating the distal portion of the bone cutting tool about a longitudinal axis while driving the fluted tip of the bone cutting tool into a cortical portion of the bone up to a first predetermined depth to form a first bore extending from the outer surface of the bone;

driving without rotating the bone cutting tool in an axial direction to a second predetermined depth to form an elongated keyway slot radially extending from the first bore and through the cortical portion of the bone and along a longitudinal portion of the first bore with the cutting tooth of the bone cutting tool;

rotating the bone cutting tool to form a second bore in a cancellous portion of the bone, the first bore and the second bore having a shoulder extending therebetween;

rotationally aligning a marking line on the bone cutting tool with the keyway slot; and

removing the bone cutting tool from the hole formed by the first and second bores while the marking line is aligned with the keyway slot.

**12**. The method of claim **11**, further comprising:

inserting a repair tissue into the second bore; and

positioning a fixation device relative to the first bore to retain the repair tissue in the second bore.

**13**. The method of claim **11**, wherein rotating the bone cutting tool about the longitudinal axis is performed with a driver attached to a proximal end of the bone cutting tool, the method further comprising:

removing the driver from the proximal end of the bone cutting tool; and

striking the proximal end of the bone cutting tool to drive the bone cutting tool in the axial direction to the second predetermined depth; and

reattaching the driver to the proximal end of the bone cutting tool for rotating the bone cutting tool about the longitudinal axis to form the second bore through the cancellous portion of the bone.

**14**. The method of claim **11**, wherein the first predetermined depth is greater than the depth of the cortical portion of the bone.

**15**. The method of claim **11**, further comprising:

positioning a guide wire within the bone; and

guiding the bone cutting tool over the guide wire before bringing the bone cutting tool into engagement with the outer surface of the bone.

**16**. The method of claim **11**, wherein the bone cutting tool is brought into engagement with an anterior cortical portion of a tibia to form the hole in the tibia.

**17**. The method of claim **16**, wherein inserting the repair tissue includes inserting an anterior cruciate ligament graft into the hole formed in the tibia.

**18**. The method of claim **11**, wherein forming the first bore and the second bore includes forming the first bore having a first diameter and forming the second bore having a second diameter, where the first diameter is less than the second diameter.

**19**. A method for forming a hole in a bone, the method comprising:

bringing a bone cutting tool into engagement with an outer surface of the bone, the bone cutting tool having a distal portion with a fluted tip and a cutting tooth proximally to the fluted tip and spaced a distance away from a distal-most end of the fluted tip;

rotating the distal portion of the bone cutting tool about a longitudinal axis while driving the fluted tip of the bone cutting tool into a cortical portion of the bone up to a first predetermined depth to form a first bore extending from the outer surface of the bone;

driving without rotating the bone cutting tool in an axial direction to a second predetermined depth to form an elongated keyway slot radially extending from the first bore and through the cortical portion of the bone and along a longitudinal portion of the first bore with the cutting tooth of the bone cutting tool; and

rotating the bone cutting tool to form a second bore in a cancellous portion of the bone, the first bore and the second bore having a shoulder extending therebetween, wherein the second bore is distal to the first bore in relation to the outer surface of the bone.

**20**. The method of claim **19**, further comprising:

aligning a marking line on the bone cutting tool with the keyway slot; and

removing the bone cutting tool from the hole formed by the first and second bores while the marking line is aligned with the keyway slot.

**21**. The method of claim **19**, further comprising:

inserting a repair tissue into the second bore; and

positioning a fixation device relative to the first bore to retain the repair tissue in the second bore.

**22**. The method of claim **21**, wherein inserting the repair tissue includes inserting an anterior cruciate ligament graft into the hole formed in the tibia.

**23**. The method of claim **19**, further comprising:

positioning a guide wire within the bone; and

guiding the bone cutting tool over the guide wire before bringing the bone cutting tool into engagement with the outer surface of the bone.

**24**. The method of claim **19**, wherein the bone cutting tool is brought into engagement with an anterior cortical portion of a tibia to form the hole in the tibia.

**25**. The method of claim **19**, wherein forming the first bore and the second bore includes forming the first bore having a first diameter and forming the second bore having a second diameter, where the first diameter is less than the second diameter.

**26**. The method of claim **19**, wherein driving without rotating the bone cutting tool in an axial direction to a second predetermined depth includes striking a proximal end of the bone cutting tool to drive the bone cutting tool in the axial direction to the second predetermined depth.

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